ECEN 150 Lab 9 – Maximum Power Transfer

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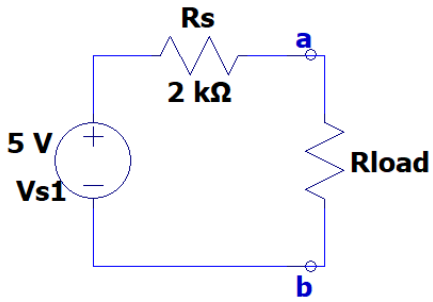
Purposes: (30 points total)

- Experimentally demonstrate the Maximum Power Transfer Theorem.
- Gain experience using Excel to calculate values and plot data.
- Practice using series and parallel combinations of resistors to create the desired resistance.

Procedure:

Part 1. Construct the circuit and measure with different load resistances.

Step 1: Construct the circuit.



- Grab **seven** 2 kΩ resistors.
- Construct the circuit to the right **without wires**. The first R_{load} value used will be 2 kΩ.
- Measure V_{load} (i.e., V_{ab}) using a voltmeter. It should be around 2.5 V.

Step 2: Create an Excel sheet to record your values.

	A	B	C	D
1	Rload ideal (ohms)	Rload measured	Vload (V)	Pload (W)
2	2000	2052	2.5	
3	1000			
4	667			
5	3000			
6	1500			
7	4000			

- Create a new Excel sheet to resemble the one shown here.
- **Enter** the value you *measured* for **Vload** into your Excel sheet in the row for R_{load} = 2000 ohms.
- ***Measure* and enter** the actual value of your Rload and enter it into the spreadsheet.

Step 3: Vary R_{load} and record V_{load}

- Using series and/or parallel combinations of 2 kΩ resistors, create each of the R_{load} values shown in the Excel sheet above.
  - Measure V_{load} **and** R_{load} each time and **enter** them in your Excel sheet.
    - *Remember to measure Rload with the power supply disconnected.
  - *Don't use any wires! (You might need a single wire for the 1500 Ω Rload.)

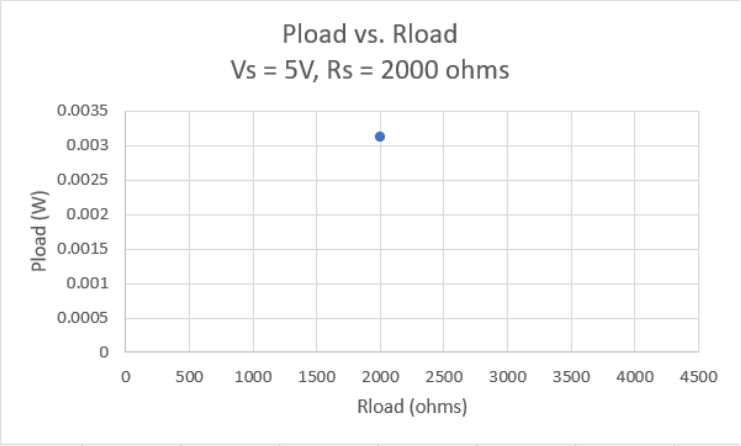
Part 2. Plot P_{load} vs. R_{load}

- In the "P_{load}" Excel column, enter an equation to calculate the power delivered to each load.
  - To compute $P_{load} = V_{load}^2 / R_{load,measured}$, enter the following (see below): =C2^2 / B2
  - *You can click on cell A2 (or whatever your cell is) and cell B2 (or whatever) rather than typing them.

A	B	C	D
Rload ideal (ohms)	Rload measured	Vload (V)	Pload (W)
2000	2052	2.5	=C2^2/B2

- Copy/paste this equation into each row under the P_{load} column. This will calculate P_{load} for each V_{load} and $R_{load,measured}$ pair. *Be sure to use measured Rload, not the ideal value.

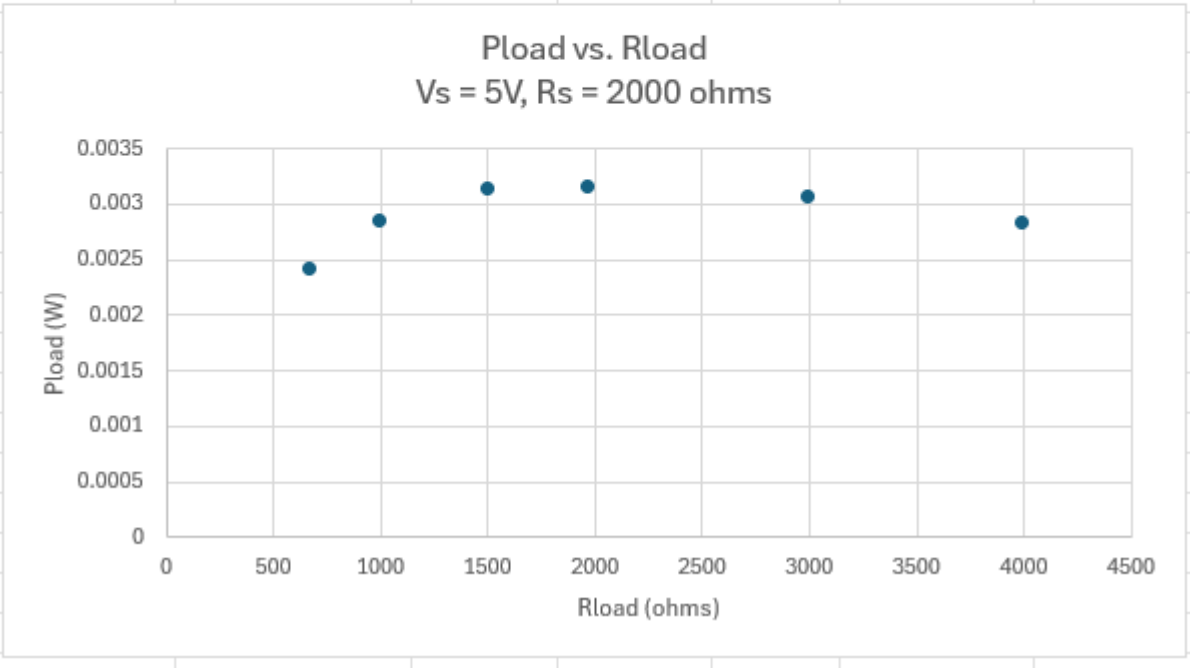
- Using Excel, plot your data with P_{load} on the y-axis and R_{load} on the x-axis.
    - **Ensure the labels are modified to match** the example shown here.
    - *Refer to the Appendix in Lab 7 if you need guidance.
    - Your data should create a concave-downward curve (not shown).



Question 1: Paste a screenshot below **showing all your values** as well as **your plot**. (**14 points total**; 7 points for plot, 7 points for data values)

(Paste Excel screenshot here showing **all data in the cells AND the plot**) (delete the example below and replace with your completed data table and plot.

A	B	C	D	E	F	G
Rload ideal (ohms)	Rload measured	Vload (V)	Pload (W)			
2000	1969	2.496	0.00316405			
1000	996	1.688	0.00286079			
667	665	1.267	0.00241397	Max =	0.003164051	
3000	2989	3.03	0.00307156			
1500	1499	2.169	0.00313847			
4000	3993	3.365	0.00283577			



Question 2a: Which value of R_{load} received the most power? __2 kΩ (ideal) or 1969Ω (measured)_ (2 points)

Question 2b: Does this support the maximum power theory? Why or why not? Answer in the box below using 1-2 sentences. (4 points)

Yes it does support the maximum power theory because the maximum power should be made when Rload = Rth. When we made Rload a 2kΩ and the Rth resistor a 2kΩ, that resulted in the max power.

Question 2c: What was the maximum power delivered to the load? _____0.003164051 W_____ (2 points)

*****Demo your circuit & show your data to the TA and then take Lab 9: Quiz 1*****

Part 3. Conclusions statement.

Write a brief conclusions statement that discusses all the original purposes of the lab. Please use complete sentences and correct grammar to express your thoughts on how you fulfilled the purposes of the lab:

Purposes (repeated):

- Experimentally demonstrate the Maximum Power Transfer Theorem.
- Gain experience using Excel to calculate values and plot data.
- Practice using series and parallel combinations of resistors to create the desired resistance.

Conclusions (8 points):

The maximum power theorem states that the maximum power delivered to the load is when the load resistance equals the equivalent resistance. We demonstrated that by keeping the equivalent resistance constant and changing the load resistance to show how the power delivered to it changed with different resistance values. We gained experience using Excel by calculating the power using a formula referencing our measured load resistance and voltage we put in separate columns. We also gained experience by plotting that data in an easy to see graph. To create the desired load resistances, we also practiced using series and parallel combinations of resistors instead of going to look for a resistor with that specific value.

Congratulations, you have completed Lab!
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